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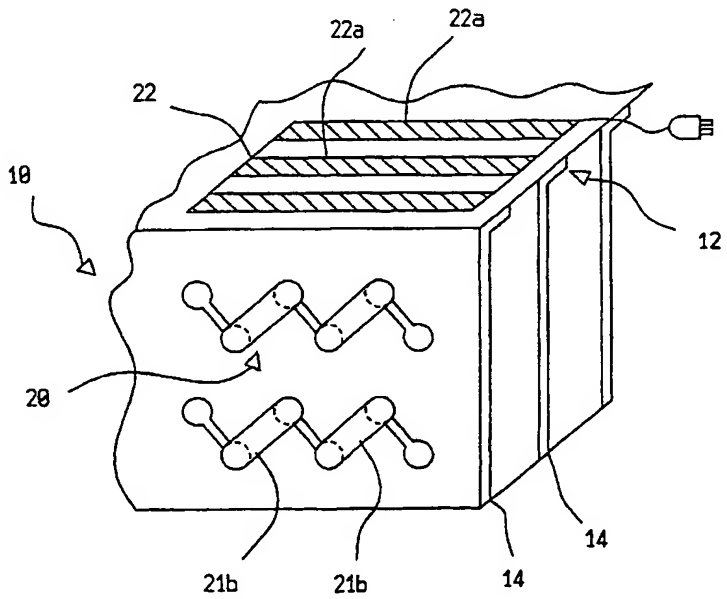
(54) Title: A DEVICE FOR THE RAPID DEFROSTING OF THE SURFACE OF EVAPORATORS



(57) Abstract: A device for the rapid defrosting of ice (12) which is comprised of resistive sheets (22) placed over an evaporator (10) which include a number of cooling plates (14). The resistive sheets (22) and the cooling plates (14) are physically in contact therebetween, the physical contact is made in a number of areas where thermal exchange surfaces (16, 30) are located, so as to increase the efficiency of heat transmission from the resistive sheets (22) to the cooling plats (14).

WO 03/008880 A1

A device for the rapid defrosting of the surface of evaporators.

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The present invention relates to a device which is applied to an evaporator in order to defrost the ice layer build-up, used in refrigeration circuits or units.

The evaporators in refrigerating circuits usually consist of a number of cooling plates parallelly arranged and suitably spaced therebetween. Openings are obtained in the cooling plates, inside which a cooling coil is inserted. A refrigerant circulates inside the cooling coil which, thanks to the physical contact and, then, to the thermal exchange between the coil and the cooling plates, allows for the lowering of the temperature of the plates and, consequently the cooling of the space wherein the evaporator is contained.

It is known that, due to the humidity always existing in the air and due to the notably low temperatures of the cold surfaces (coil and cooling plates), evaporators are covered by an ice layer, the thickness of which continuously increases over time. The ice layer formed reduces the thermal exchange and, then, reduces the efficiency of the refrigerating circuit, whereby the circuit must continually function, with a consequent increase in the cost and thus a greater wear on the components of the circuit.

Therefore, different solutions have been developed in order to eliminate this drawback, by using electrical resistances to defrost the surface of the evaporator, such as plated resistances. However, these resistances have a drawback in producing heat in certain positions and, consequently, the defrosting time is increased.

One better solution is described in the German Patent N° 1816640 filed on 23.12.1968 in the name of Robert Steger which consists of a resistive sheet placed on the walls of the evaporator.

This solution is innovative respect to the defrosting system described above, because the heat generated is distributed over a surface greater than that of the usual system, such as that of the plated resistances. Nonetheless, this solution has some drawbacks due to the fact that the thermal exchange between the

resistive sheet and the cooling plates is not optimized, because the improved characteristics of the new solution are not completely employed. Therefore, the above-mentioned drawbacks remain, i.e. the defrosting time is still long with a consequential increase in the costs.

The aim of the present invention is to create a device which permits to fully use the characteristics offered by the resistive sheets and, then, a device wherein the heat exchange between the resistive sheets and said cooling plates is more fully optimized.

The aim is reached through a device of the type initially indicated, namely a device for the rapid defrosting of the surface of evaporators comprising pellicular resistive means, said evaporator including a number of cooling plates spaced parallelly spaced apart therebetween having openings in which a cooling coil is inserted, characterized in that said pellicular resistive means comprise at least one PTF resistive sheet, said at least one PTF resistive sheet and said cooling plates being physically in contact therebetween, that said physical contact is located in a number of areas and that, at said physical contact areas, surfaces of thermal exchange are provided so as to increase the efficiency of heat transmission from said at least one PTF resistive sheet to said cooling plates.

In particular, the surfaces of thermal exchange are made of perpendicular flaps located on the edges of the cooling plates, the perpendicular flaps being located substantially in a plane and said at least one PTF resistive sheet being placed on the perpendicular flaps.

In such a way, the heat transmission between the PTF resistive sheet and the cooling plates occurs over a large surface of contact, therefore allowing for an optimum distribution of the heat generation. The defrosting time is notably decreased and, at the same time, it is possible to decrease the electrical power dissipated by the PTF resistive sheet.

In order to simplify the construction, said perpendicular flaps are obtained by L-bending the adjacent edges of said cooling plates.

Therefore, it is evident that the present invention allows for an efficiency and an efficacious transmission of the heat generated by the PTF resistive sheet.

These and other advantages of the present invention will become more evident form the following detailed description given by an illustrative and non limitative purpose, with reference to the subsequent enclosed drawings wherein:

- figure 1 is a partial and schematic prospective view of a device according to the present invention;
- figure 2 is a partial prospective view of a cooling plate of the device of figure 1;
- figure 3 is a partial cross section of the evaporator of figure 1;
- figure 4 is a partial cross section of the evaporator containing the device according to a first variant of the invention;
- figure 5 is a partial prospective view of a cooling plate according to a second variant of the invention;
- figure 6 is a top view of a resistive sheet according to a third variant of the invention;

An evaporator indicated by 10 is represented in figure 1, comprising a device 12 for the rapid defrosting of the surface of the evaporator.

The evaporator 10 comprises a number of cooling plates 14 (shown better in figure 2) each having a rectangular shape with an L-shaped bended edge 14a to form a perpendicular flap 16. The dimensions of the L-shaped bended edges 14 are the same so as the perpendicular flaps 16 are arranged on the same plane.

Openings 18 are made in the cooling plates 14 inside which a cooling coil 20 is inserted and is comprised of rectilinear portions 21a and curved portions 21b, as represented in figure 3. More precisely, the openings 18 have wide, and circle-like ends 18a, so as to house the rectilinear portions 21a of the cooling coil 20 which orthogonally passes into all the cooling plates 14.

The device 12 comprises a resistive sheet 22 of the PTF-type (polymer thick

film) placed on the perpendicular flaps 16 of the cooling plates 14. The PTF resistive sheet 22 contains various conductive areas or tracks 22a electrically connected therebetween which are supplied by an electrical supply source. The resistive sheet 22 has preferably PTC characteristics (positive coefficient temperature) so that, when the temperature increases, the value of the electrical resistance increases, thus limiting the electrical current which flows into it.

Thanks to the surfaces of the thermal exchange thus made, an optimum trasmission of heat is guaranteed.

The edges 14a of the cooling plates 14 may all be L-bent on the same side, as indicated in figure 2, or each edge 14a may be indifferently bent on one side or on the other side. Furthemore, it is possible to bend all the edges 14a of the cooling plates 14, or only a limited number of them, for example only the odd numbers, i.e. the first one, the third one and so on. In order to assure a sufficient transmission of heat, the number of the cooling plates 14, in which the edges 14a have been bent into an L-shape, should be preferably greater than 30% of the total amount. For the same reason, the perpendicular flaps 16 extend over a length equal to that of the cooling plates 14 and over a width equal to at least two times the thickness of the cooling plates 14.

In figure 4 the first modification of the invention is represented, in which the device 12 consists of applying a resistive sheet 22 over the edges 14a of the cooling plates 14 by interposing a thermal conductive paste 30, of a well-known type such as those composed of silicone and metallic oxides. The paste 20 allows for an efficacious transmission of the heat from the resistive sheet 22 to the edges 14a of the cooling plates 14.

Preferably, the paste 30 should be adhesive and electrically insulated. In such a way the adhesive paste 30 allows for a firm fixing of the resistive sheet 22 to the edges 14a of the cooling plates 14 and, being electrically insulated, it avoids electrical contacts between the parts under tension (the resistive sheet 12) and the evaporator 10, in case of laceration of the resistive sheet 22.

In figure 5 a second variant of the invention is represented, wherein the resistive sheets 122 have the same shape, but slightly smaller in respect to that of the cooling plates 14, and they are placed over the surfaces of the cooling plates 14. Openings 124 are made into the resistive sheets 122 so that the latter do not cover the openings 18 of the cooling plates 14: It is possible to apply a resistive sheet 122 over each cooling plate 124, or only over a reduced number of them, but preferably greater than 30%.

In figure 6 a third variant of the invention is illustrated, wherein the resistive sheets 222 used are comb-shaped with prongs 224 designed to be inserted into the openings 18 of the cooling plates 14. The width of the prongs 222 must be equal to the width of the openings 18 of the cooling plates 14.

The total number of the resistive sheets 222 and, then, of the prongs 224 could fill all the openings 18 of the cooling plates 14, or only a reduced number of them, but still preferably more than 30% of the total amount.

It is evident that conceptually and functionally equivalent variants fall inside the protection field of the present invention.

For example, it is possible to use a thermically conductive paste 30 also in cases wherein the resistive sheet 22 is placed over the flaps 16 obtained by L-bending the ends 14a of the cooling plates 14.

Claims

1. Device for the rapid defrosting of the surface of evaporators comprising pellicular resistive means (22), said evaporator (10) including a number of cooling plates (14) spaced parallelly spaced apart therebetween having openings (18) in which a cooling coil (20) is inserted, characterized in that said pellicular resistive means comprise at least one PTF resistive sheet (22), said at least one PTF resistive sheet (22) and said cooling plates (14) being physically in contact therebetween, that said physical contact is located in a number of areas and that, at said physical contact areas, surfaces (16,30) of thermal exchange are provided so as to increase the efficiency of heat transmission from said at least one PTF resistive sheet (22) to said cooling plates (14).
2. Device for the rapid defrosting of the surface of evaporators according to claim 1, characterized in that, at said physical contact areas, said surfaces (16,30) of thermal exchange are made on perpendicular flaps (16) located at the edges (14a) of the cooling plates (14), said perpendicular flaps (16) being substantially located in a plane and said at least one PTF resistive sheet (22) being placed over the perpendicular flaps (16).
3. Device for the rapid defrosting of the surface of evaporators according to claim 2, characterized in that said perpendicular flaps (16) are obtained by L-bending the adjacent edges (14a) of said cooling plates (14).
4. Device for the rapid defrosting of the surface of evaporators according to claim 3, characterized in that the number of the cooling plates (14), whose edges (14a) are L-bent, are superior to that of 30% of the total amount.
5. Device for the rapid defrosting of the surface of evaporators according to claim 2 or 3, characterized in that said perpendicular flaps (16) extend to a length equal to the length of the cooling plates (14) and to a width equal to at least two times the width of the cooling plates (14).
6. Device for the rapid defrosting of the surface of evaporators according to claim 1, characterized in that said surfaces of thermal exchange comprise a

thermally conductive paste (30) placed between said cooling plates (14) and said at least one PTF resistive sheet (22).

7. Device for the rapid defrosting of the surface of evaporators according to claim 6, characterized in that said thermally conductive paste (30) is adhesive.

8. Device for the rapid defrosting of of the surface of evaporators according to claim 6, characterized in that said thermally conductive paste (30) is electrically insulated.

9. Device for the rapid defrosting of the surface of evaporators according to claim 6, characterized in that said at least one PTF resistive sheet (22) is placed on said bent flaps (16) by interposing said thermally conductive paste (30).

10. Device for the rapid defrosting of the surface of evaporators according to claim 1, characterized in that said surfaces of thermal exchange consist of cooling plates (14).

11. Device for the rapid defrosting of the surface of evaporators according to claim 10, characterized in that said at least one PTF resistive sheet (122) has a dimension equal to or inferior to that of the cooling plates (14), each of said at least one PTF resistive sheet (122) being placed over the surface of the cooling plates (14), said PTF resistive sheets (122) having openings (124) so that the sheets (122) do not cover the openings (18) of the cooling plates (14).

12. Device for the rapid defrosting of the surface of evaporators according to claim 11, characterized in that said at least one PTF resistive sheet (122) is applied to at least 30% of the number of the cooling plates (14).

13. Device for the rapid defrosting of the surface of evaporators according to claim 1, characterized in that said pellicular resistive means comprise at least one PTF resistive sheet (222) having a comb-shape whose prongs (224) are inserted in said openings (18) of said cooling plates (14).

14. Device for the rapid defrosting of the surface of evaporators according to

claim 13, characterized in that said at least one PTF resistive sheet (222) is in such that a number of prongs (224) are inserted into at least 30% of the openings (18) of said cooling plates (14).

15. Device for the rapid defrosting of the surface of evaporators according to any of the previous claims, characterized in that said at least one PTF resistive sheet (22,122,222) has PTC characteristics.

16. Evaporator provided with the device as claimed in any of the previous claims.

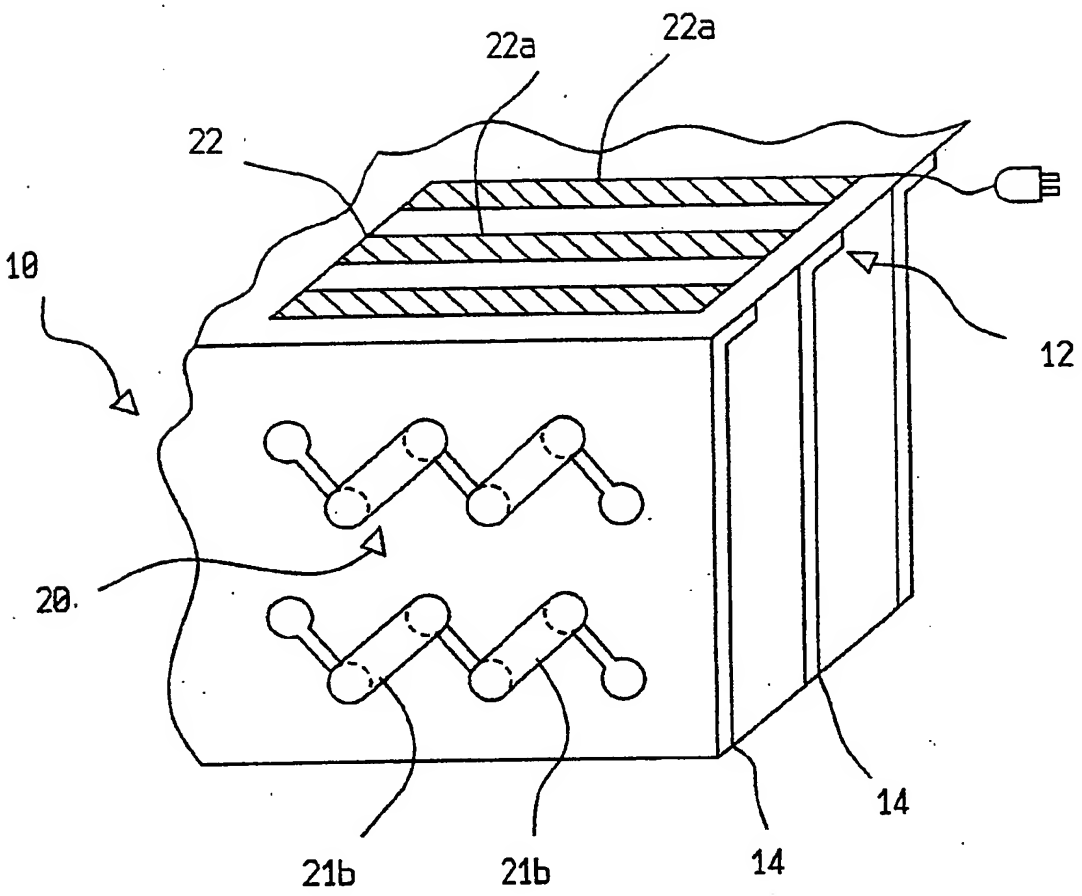

Fig. 1

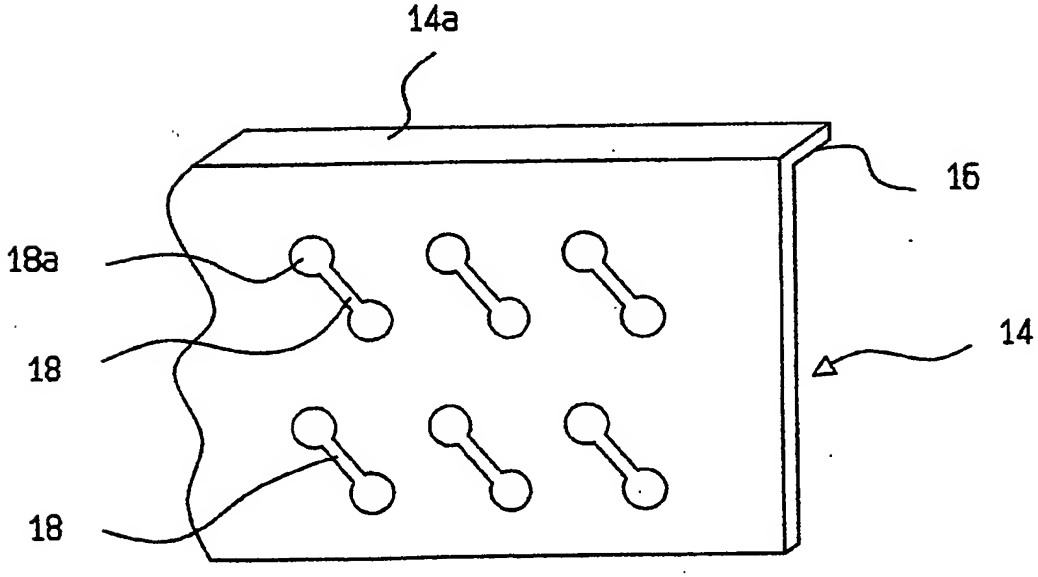

Fig. 2

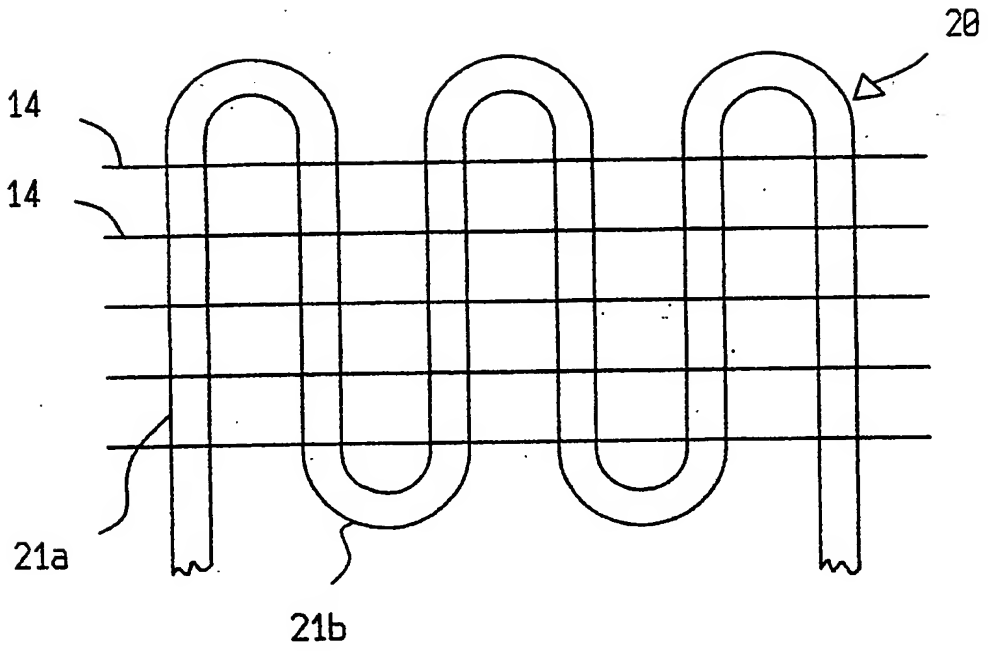

Fig. 3

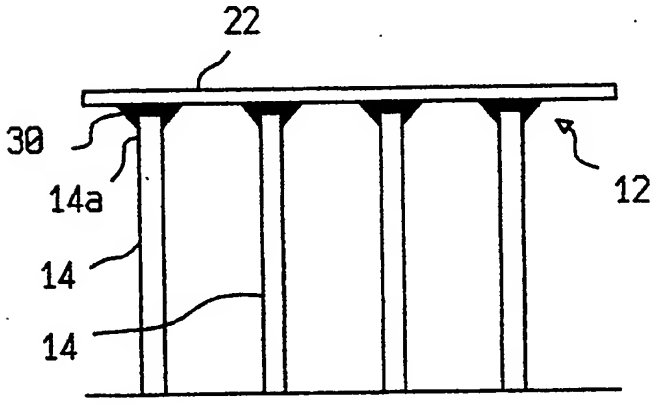

Fig. 4

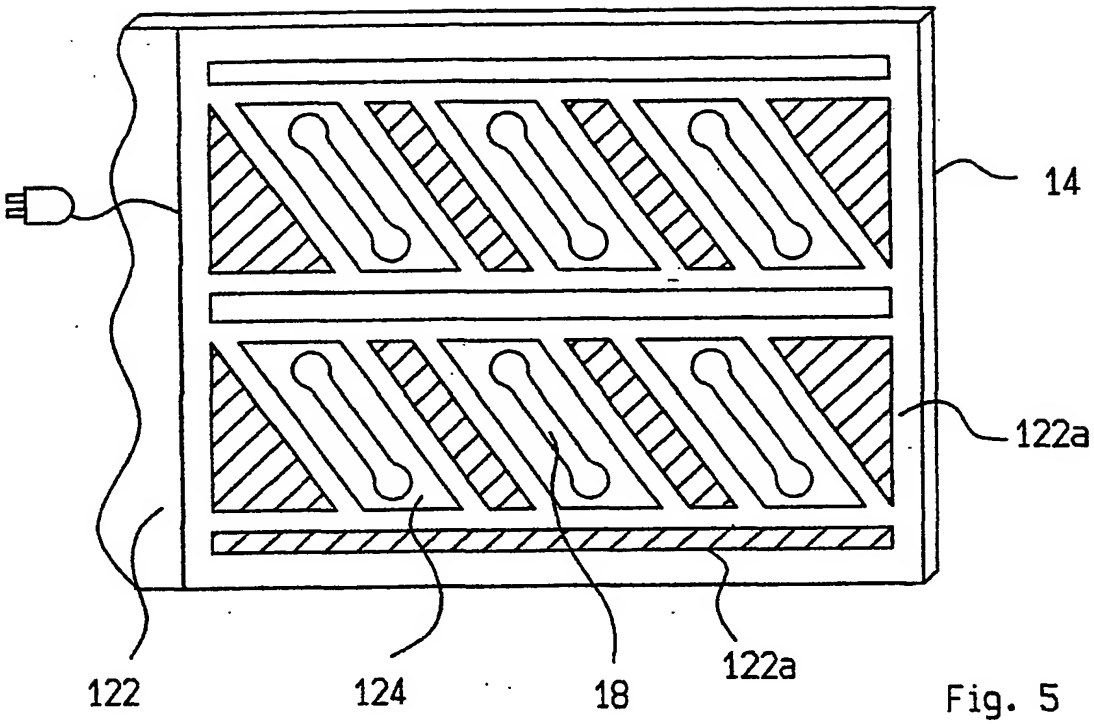

Fig. 5

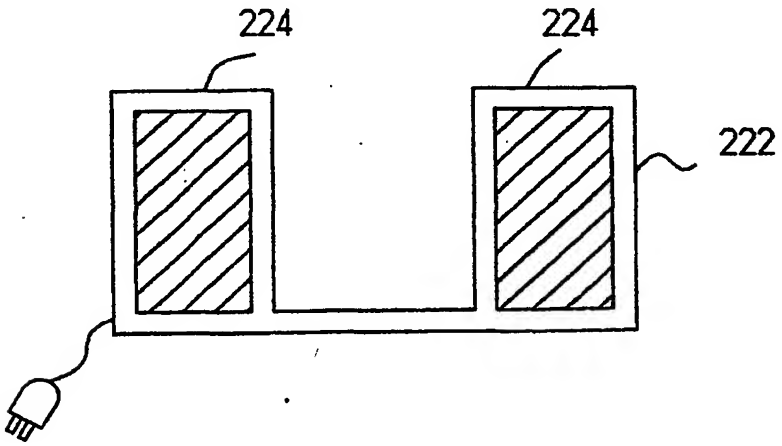

Fig. 6

INTERNATIONAL SEARCH REPORT

Int. ional Application No
PCT/IT 02/00349

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F25D21/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F25D H05B H01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 004 835 A (WHIRLPOOL CO) 31 May 2000 (2000-05-31) paragraph '0002! paragraphs '0006!,'0007! paragraphs '0010!-'0019! claims 1-15 figures 2,3	1-5,10, 15,16
A	---	6,13
A	EP 0 918 339 A (ACHESON IND INC) 26 May 1999 (1999-05-26) paragraph '0006! paragraph '0009! paragraphs '0055!-'0060! claims 1,9,10	1,15

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
2 October 2002	14/10/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	CORREIA DOS REIS, I

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INTERNATIONAL SEARCH REPORT

International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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